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(54) **POSITIVELY ENGAGED LOCKING SYSTEM FOR A VEHICLE SEAT**

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(57) **ABSTRACT**

A vehicle seat track assembly includes a first track having first and second spaced apart walls. Each of the first and second walls include a plurality of openings formed therein. A second track is slidably mounted relative to the first track. The vehicle seat track assembly further has a locking mechanism including a first pin carried by the second track and slidably movable between an engaged position such that the first pin extends through one of the plurality of openings formed in the first wall of the first track and a disengaged position such that the first pin is retracted from the plurality of openings formed in the first wall of the first track. A second pin is carried by the second track and is slidably movable between an engaged position such that the second pin extends through one of the plurality of openings formed in the second wall of the first track and a disengaged position such that the second pin is retracted from the plurality of openings formed in the second wall of the first track. The first and second pins are movable in directions different from one another when moving into their respective engaged positions.

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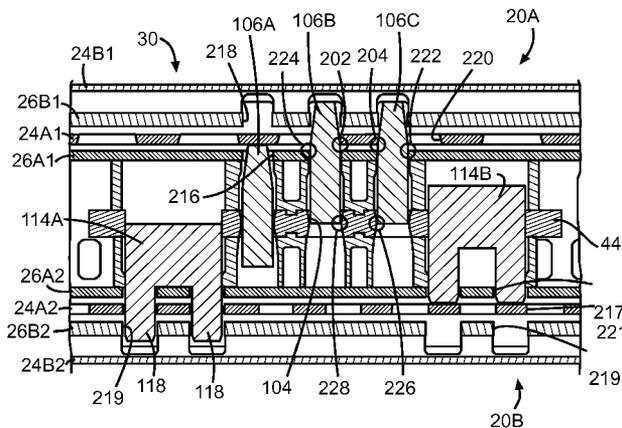
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297/344.1, 344.11

See application file for complete search history.

20 Claims, 8 Drawing Sheets



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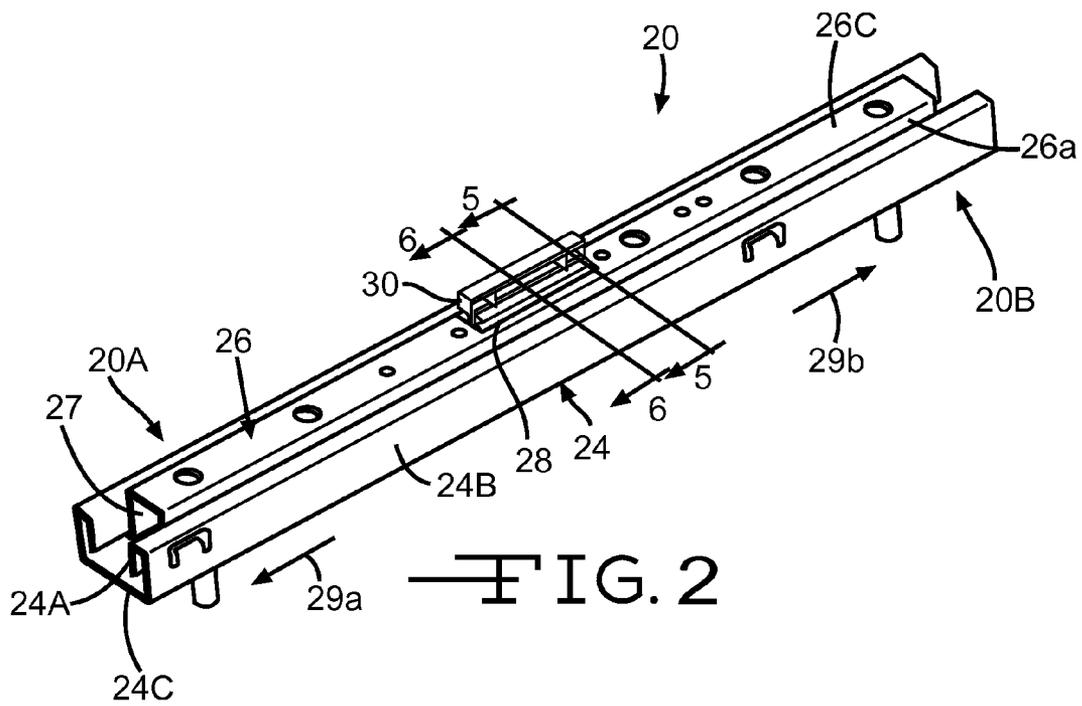
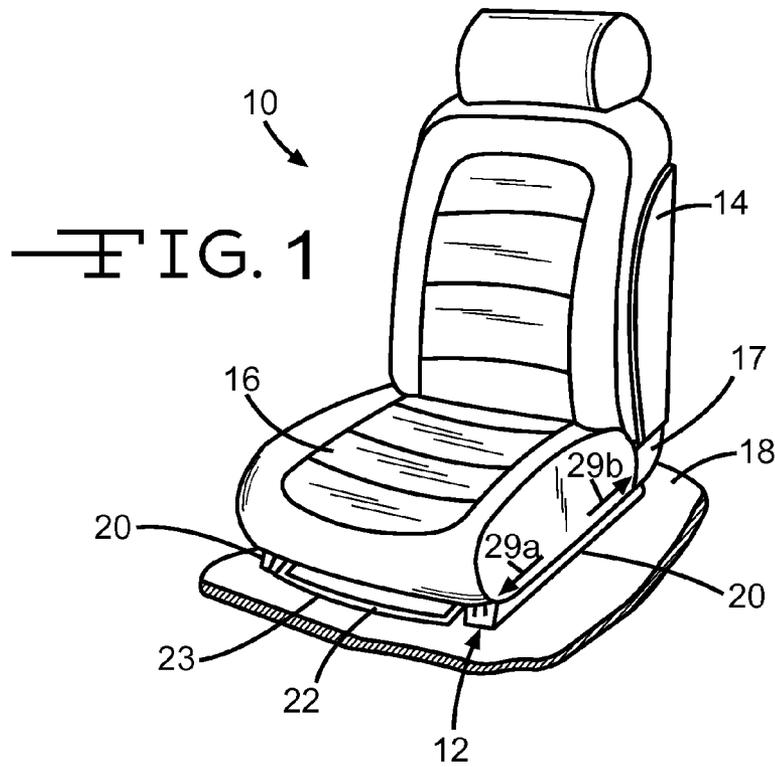
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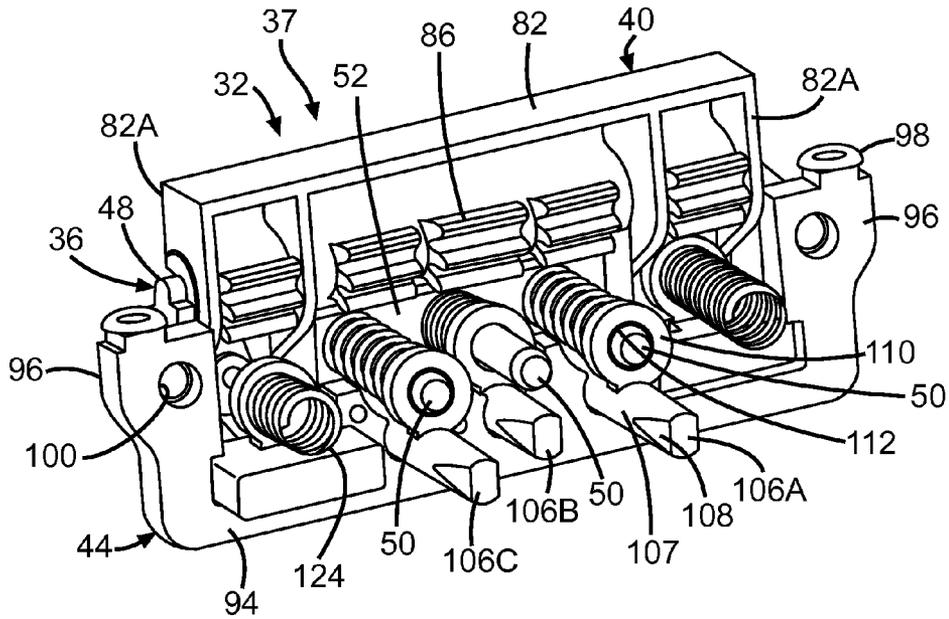


FIG. 3

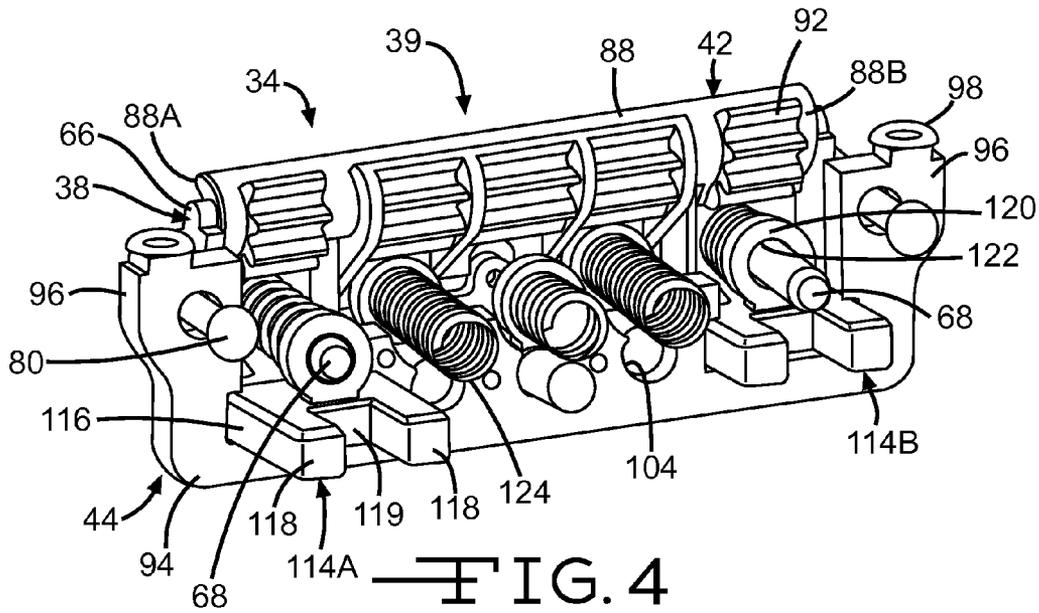
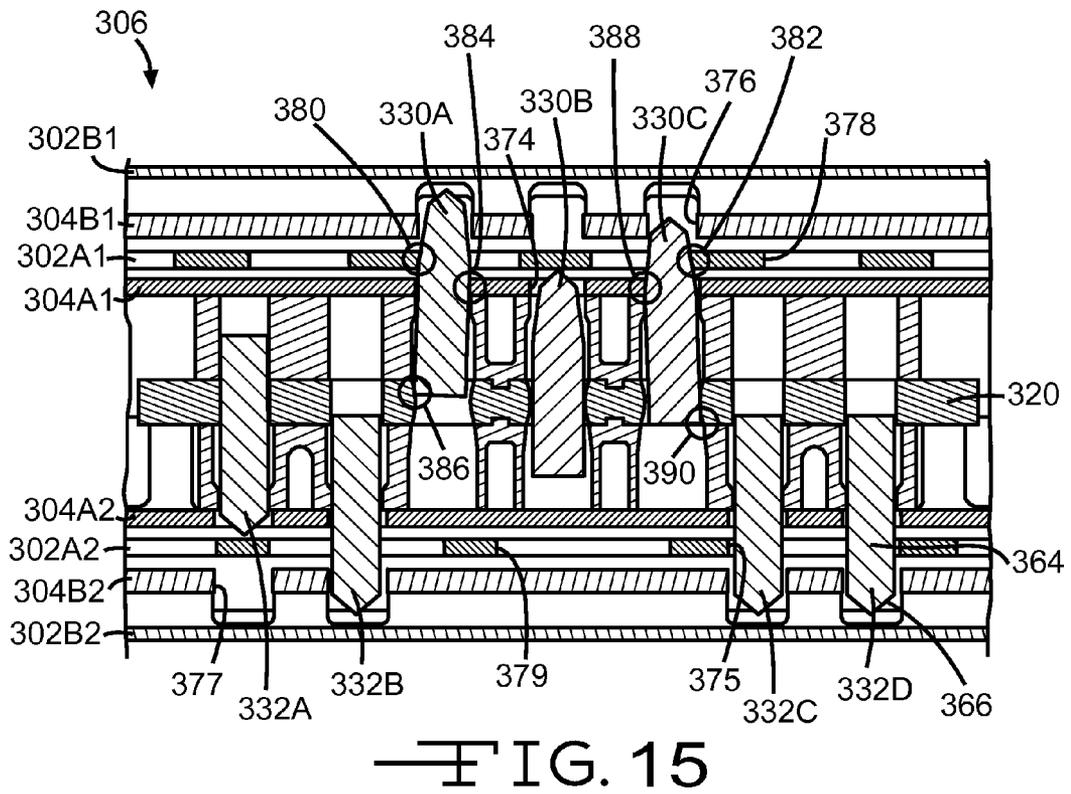
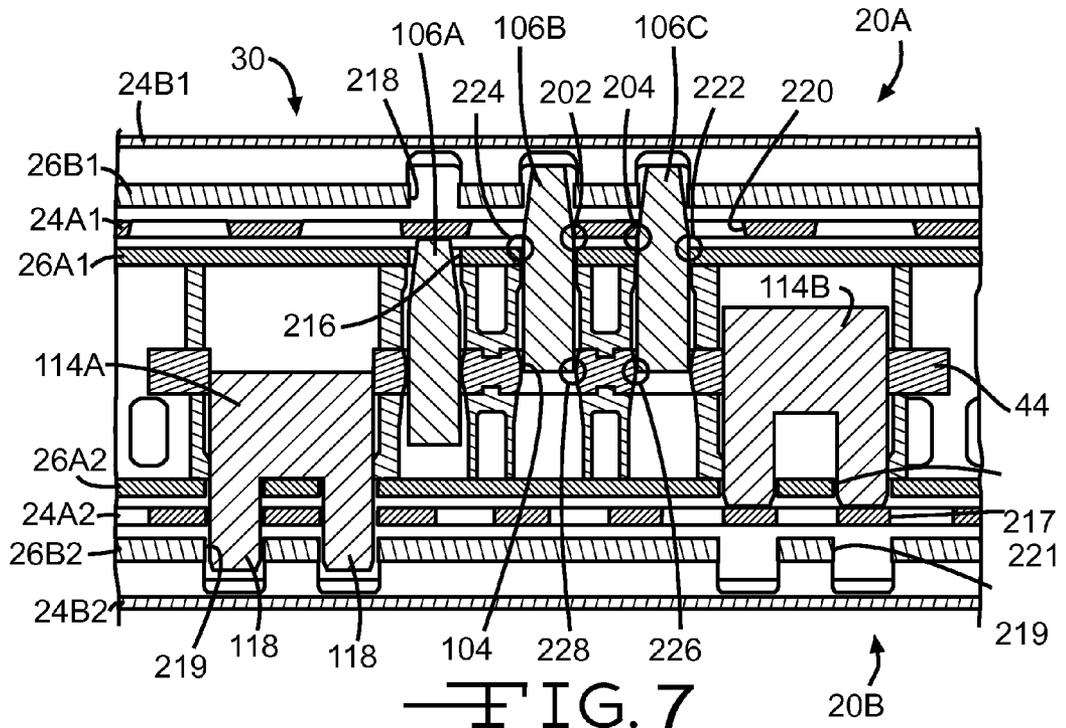
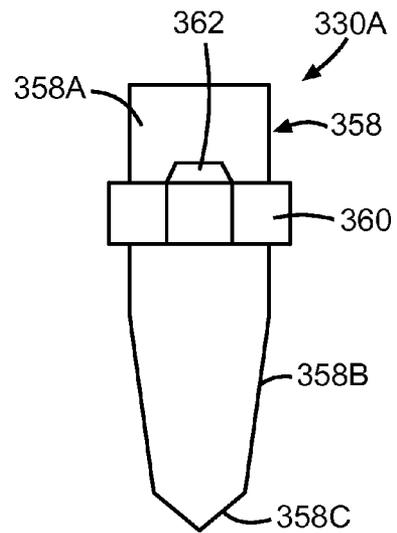
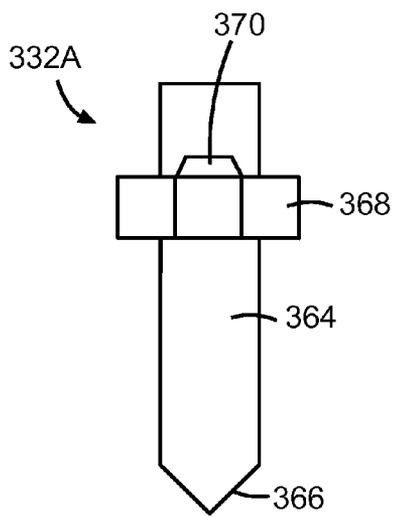
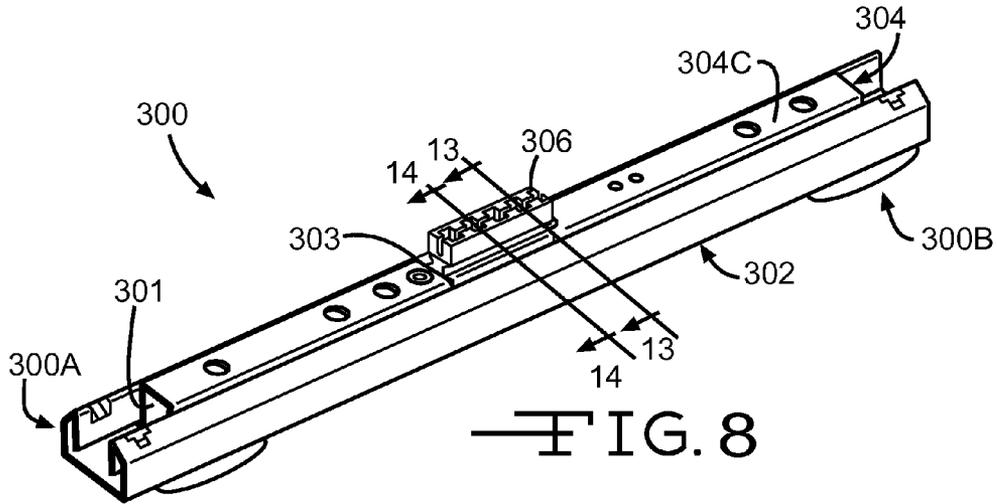


FIG. 4





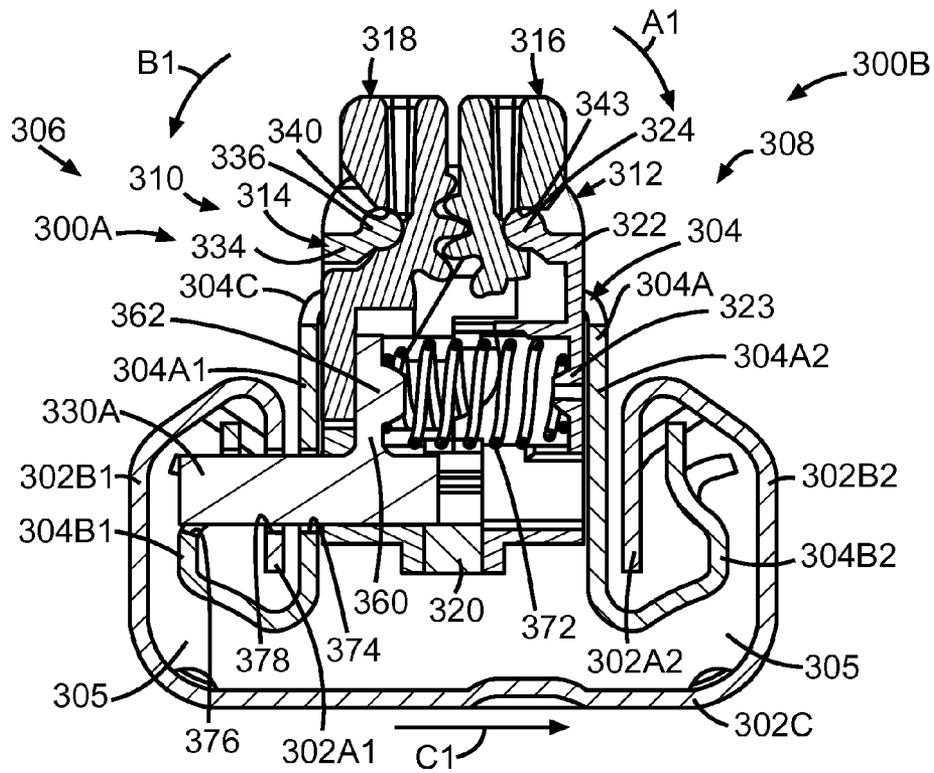


FIG. 13

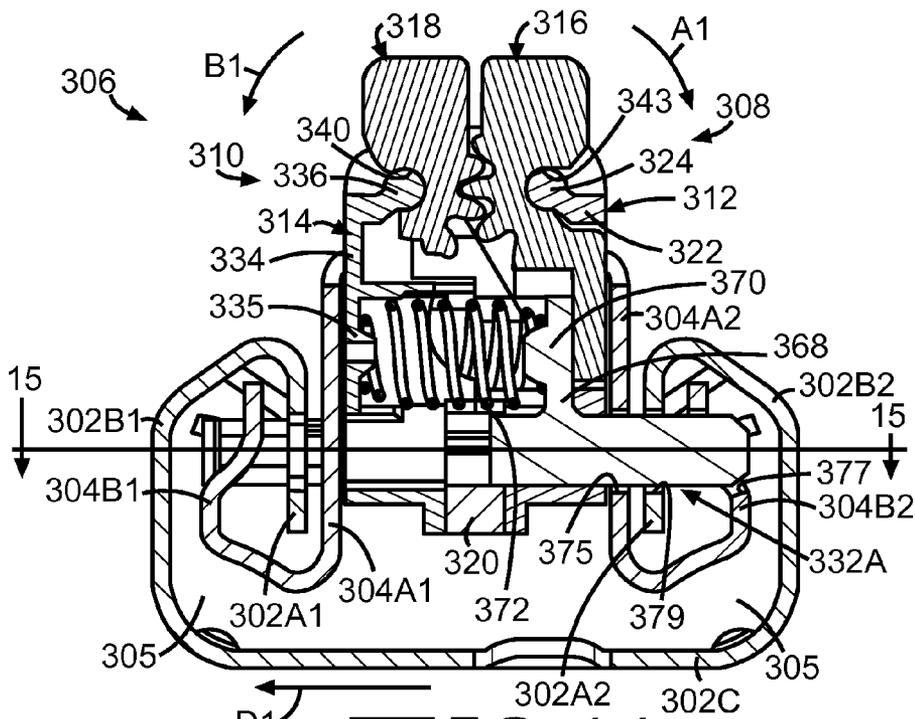


FIG. 14

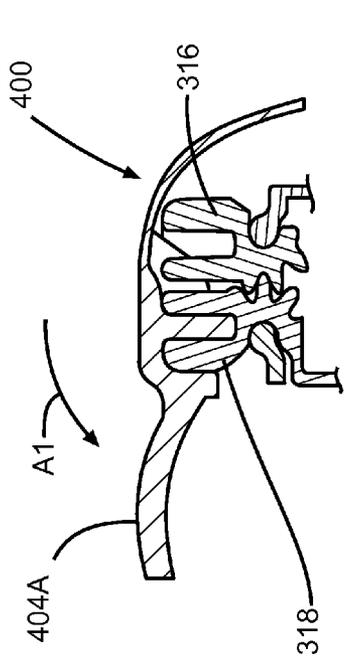


FIG. 17

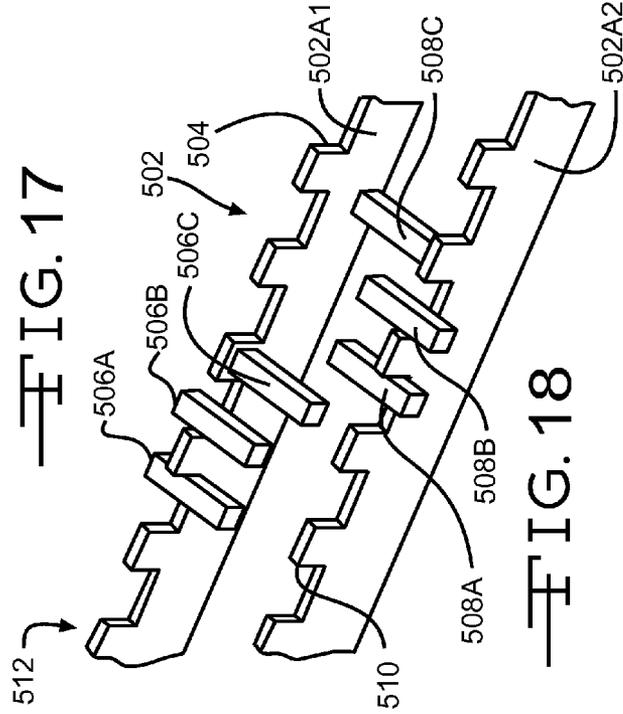


FIG. 18

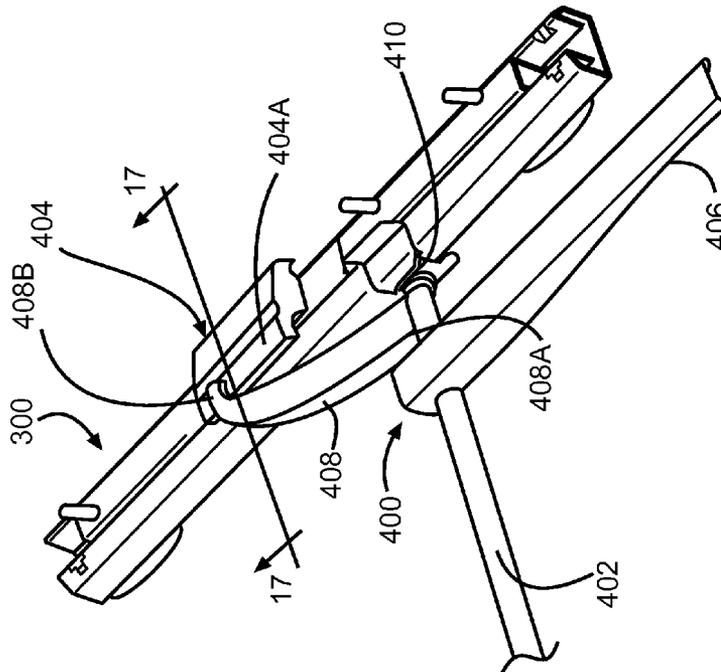


FIG. 16

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POSITIVELY ENGAGED LOCKING SYSTEM FOR A VEHICLE SEAT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/138,829 filed Dec. 18, 2008.

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BACKGROUND

Various embodiments of a seat track mechanism are described herein. In particular, the embodiments described herein relate to an improved positively engaged locking (PEL) system or mechanism for a vehicle. Vehicles commonly include seats that are movably mounted on a vehicle floor to provide an adjustable position of the seat relative to the vehicle floor in a fore and aft direction. For example, the occupant of the driver's seat may want to adjust his or her position relative to the steering wheel and brake and accelerator pedals. The vehicle seat may be mounted on tracks for slidably moving the seat in the fore and aft direction along the vehicle floor. Commonly, a pair of track assemblies is mounted on the underside of the seat between the vehicle floor and the seat bottom. One track assembly is generally mounted on the inboard side of the seat, and the other track assembly is generally mounted on the outboard side of the seat. A typical track assembly includes a lower track bolted to the vehicle floor. An upper track is mounted on the seat. The upper track is slidably mounted on the lower track. Ball or roller bearings are commonly provided between portions of the tracks for ease of moving the upper track relative to the lower track.

The track assemblies include a locking assembly which prevents the tracks from moving relative to one another during normal usage of the seat. When the user wants to move the seat position, the user actuates the locking assembly to an unlatched position, thereby permitting the seat to be moved to a desired position. After the seat is in its desired position, the user then actuates the locking assembly to its latched position, thereby preventing the seat from moving relative to the floor. U.S. Pat. Nos. 6,874,747 and 7,191,995 illustrate examples of known track assemblies which use an actuating mechanism mounted on the outside of the tracks for moving engagement pins into and out of openings formed in the tracks to provide for locked and unlocked conditions. Such track assemblies may require clearance and spacing adjacent the actuating mechanism to prevent obstruction of the operation of the track assembly. U.S. Pat. No. 6,637,712 illustrates an example of a known track mechanism that uses pins slidably mounted in a vertical orientation wherein the pins extend underneath the tracks when in their locked position. Such a track assemblies may require clearance from the vehicle floor to operate and is susceptible to obstruction hindering the operation of the track assembly.

SUMMARY

The present application describes various embodiments of a vehicle seat track assembly. One embodiment of the vehicle seat track assembly includes a first track having first and second spaced apart walls. Each of the first and second walls include a plurality of openings formed therein. A second track is slidably mounted relative to the first track. The vehicle seat

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track assembly further has a locking mechanism including a first pin carried by the second track and slidably movable between an engaged position such that the first pin extends through one of the plurality of openings formed in the first wall of the first track and a disengaged position such that the first pin is retracted from the plurality of openings formed in the first wall of the first track. A second pin is carried by the second track and is slidably movable between an engaged position such that the second pin extends through one of the plurality of openings formed in the second wall of the first track and a disengaged position such that the second pin is retracted from the plurality of openings formed in the second wall of the first track. The first and second pins are movable in directions different from one another when moving into their respective engaged positions.

Other advantages of the vehicle seat track assembly will become apparent to those skilled in the art from the following detailed description, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a vehicle seat including a seat track mechanism in accordance with the present invention.

FIG. 2 is an enlarged perspective view of a first embodiment of a seat track assembly of the seat track mechanism illustrated in FIG. 1.

FIG. 3 is an enlarged perspective view of a first portion of the positively engaged locking system (PEL) illustrated in FIG. 2.

FIG. 4 is an enlarged perspective view of a second portion of the PEL illustrated in FIG. 2.

FIG. 5 is an enlarged cross-sectional view of the PEL taken along the line 5-5 in FIG. 2.

FIG. 6 is an enlarged cross-sectional view of the PEL taken along the line 6-6 in FIG. 2.

FIG. 7 is an enlarged cross-sectional view of the PEL taken along the line 7-7 in FIG. 6.

FIG. 8 is an enlarged perspective view of a second embodiment of the seat track assembly of the seat track mechanism illustrated in FIG. 1.

FIG. 9 is an enlarged perspective view of a first portion of the PEL illustrated in FIG. 8.

FIG. 10 is an enlarged perspective view of a second portion of the PEL illustrated in FIG. 8.

FIG. 11 is an enlarged plan view of the load pin illustrated in FIG. 10.

FIG. 12 is an enlarged plan view of the free-play elimination pin illustrated in FIG. 9.

FIG. 13 is an enlarged cross-sectional view of the PEL taken along the line 13-13 in FIG. 8.

FIG. 14 is an enlarged cross-sectional view of the PEL taken along the line 14-14 in FIG. 8.

FIG. 15 is an enlarged cross-sectional view of the PEL taken along the line 15-15 in FIG. 14.

FIG. 16 is a perspective view of one embodiment of a PEL actuator mounted to the second embodiment of the seat track assembly illustrated in FIG. 8.

FIG. 17 is an enlarged cross-sectional view the PEL actuator taken along the line 17-17 of FIG. 16.

FIG. 18 is a schematic perspective view of a third embodiment of the lower track of the seat track assembly illustrated in FIG. 8.

DETAILED DESCRIPTION

Referring now to the drawings, there is illustrated in FIG. 1 a vehicle seat, indicated generally at 10, including a seat track

mounting assembly or seat track assembly, indicated generally at 12. The vehicle seat 10 can be any conventional seat design and may include a seat back 14 and a seat bottom 16. The seat back 14 may be pivotally mounted on the seat bottom 16 via a recliner mechanism 17 such that the seat back 14 can be positioned at selected recline angles relative to the seat bottom 16. The seat track mounting assembly 12 is attached to an underside of the seat bottom 16 and is adapted to be mounted on a vehicle floor 18.

The seat track mounting assembly 12 generally includes a pair of seat track assemblies, each indicated generally at 20, and a single release handle 22, commonly referred to in the industry as a towel bar. The seat track assemblies 20 are mounted on each side of the vehicle seat 10, as shown in FIG. 1. The seat track assemblies 20 permit selective sliding movement of the vehicle seat 10 relative to the floor 18 in a longitudinal direction. More specifically, the vehicle seat 10 may travel in a forward or fore direction 29a and a rear or aft direction 29b. As will be discussed below, the seat track mechanism 12 can be operated via the release handle 22 between a locked position, wherein the seat 10 is prevented from moving relative to the floor 18, and an unlocked position, wherein the seat 10 is permitted to be moved in the fore and aft directions 29a and 29b relative to the vehicle floor 18.

As illustrated in FIG. 2, one of the seat track assemblies 20 has a first or pin side 20A and a second or plate side 20B, and includes a first or lower rail or track 24 and a second or upper rail or track 26. The lower and upper tracks 24 and 26 are slidably mounted on one another. The tracks 24 and 26 are generally elongated in shape and are arranged such they extend along the fore and aft directions 29a and 29b. The lower track 24 is adapted to be attached to the vehicle floor 18, such as by a bolt or other fastener. The upper track 26 is attached to the seat bottom 16, such as on its underside. As will be discussed below, the lower and upper tracks 24 and 26 are configured to accept bearings disposed between them for supporting the tracks 24 and 26 together. The bearings also provide for a relatively low friction sliding motion between the tracks 24 and 26. The lower track 24 has a generally U-shaped cross section. The upper track 26 has an inverted generally U-shaped cross section. When connected together, an interior space or cavity 27 is defined between the tracks 24 and 26. The tracks 24 and 26 may be made of any suitable material, such as metal, and may be formed by any suitable manner, such as by stamping. The lower track 24 includes a plurality of openings 220 and 221 formed therein (best shown in FIG. 7), the reasons for which will be explained in detail below. The plurality of openings 220 and 221 are spaced from one another and positioned along the length of the lower track 24. At least one of the seat track assemblies 20 includes a locking mechanism. In the illustrated embodiment, the locking mechanism is a positively engaged locking (PEL) system or mechanism 30.

The seat track mounting assembly 12 may have a PEL 30 for each seat track assembly 20 or may have a single PEL 30 for only one of the two seat track assemblies. For simplicity, only one of the seat track assemblies 20 will be described herein, but it should be understood that the other seat track assembly 20 may also be configured in a similar manner.

The PEL 30 is connected to the release handle 22 and is operable by pivoting movement of the release handle 22. The release handle 22 is generally U-shaped defining a grasping portion 23 and a pair of leg portions (not shown) which extend from ends of the grasping portion 23.

FIGS. 3 and 4 show first and second sides 32 and 34 of the PEL 30, respectively. The illustrated PEL 30 includes a first housing portion 36 and a second housing portion 38, both also

shown in FIGS. 5 and 6. The illustrated PEL 30 also includes a first lever 40 and a second lever 42. The first and second housing portions 36 and 38, respectively, are mounted to a third housing portion or load bracket 44.

The first housing portion 36 includes a body 46 having an elongated pivot surface 48. In the illustrated embodiment, three spring guide posts 50 extend outwardly from an inner surface 52 (generally toward the right when viewing FIG. 3). Apertures may be formed through the body 46 through which plates 114A and 114B may extend.

The second housing portion 38 includes a body 64 having an elongated pivot surface 66. In the illustrated embodiment, two spring guide posts 68 extend outwardly from an inner surface 70 (generally toward the right when viewing FIG. 4). Apertures may be formed through the body 64 through which pins 106A, 106B, and 106C may extend.

The first lever 40, as shown in FIGS. 5 and 6, includes a body 82 having a first side 82A having a pivot groove 84 which pivotally engages the pivot surface 48. A second side 82B includes a plurality of first teeth 86.

The second lever 42, as also shown in FIGS. 5 and 6, includes a body 88 having a first side 88A having a pivot groove 90 which pivotally engages the pivot surface 66. A second side 88B includes a plurality of second teeth 92.

The load bracket 44 includes an elongated generally U-shaped body 94 having outwardly extending arms 96 and a plurality of pin grooves 104. Attachment posts 98 extend outwardly toward the upper track 26 for attaching the load bracket 44 to the upper track 26. Apertures 100 are formed in the arms 96 for receiving attachment pins 80.

The first housing portion 36, the first lever 40, and the springs 124 define a first actuator 37. The second housing portion 38, the second lever 42, and the springs 124 define a second actuator 39.

As best shown in FIGS. 3 and 7, the PEL 30 includes 3 pins, 106A, 106B, and 106C. The substantially cylindrical pins 106A, 106B, and 106C include a pin body 107 having a beveled end portion 108. A mounting ring 110 is attached to the pin body 107 and includes a ring aperture 112. The mounting rings 110 are slidably mounted on the posts 50.

As best shown in FIGS. 4 and 7, the PEL 30 includes 2 plates, 114A and 114B. The locking plates 114A and 114B include a plate body 116 having two substantially parallel fingers 118 extending outwardly thereof. The fingers define space 119 therebetween. A mounting ring 120 is attached to the plate body 116 and includes a ring aperture 122. The mounting rings 120 are slidably mounted on the posts 68. It will be understood that in the embodiments of the PEL described herein, the plates 114A and 114B function as a pair of connected pins.

FIG. 3 shows the first side 32 of the PEL 30 with the second housing portion 38 and the second lever 42 removed. In the illustrated embodiment, coil springs 124 are mounted on the spring guide posts 50 and 68 to bias the pins 106A, 106B, and 106C, and the plates 114A and 114B, respectively, outward of the load bracket 44. FIG. 4 shows the second side 34 of the PEL 30 with the first housing portion 36 and the first lever 40 removed. The coil springs 124 are also visible in FIG. 4. The housing portions 36 and 38, levers 40 and 42, load bracket 44, pins 106A, 106B, and 106C, and the plates 114A and 114B may be made of any suitable material, such as plastic. It will be understood that the PEL 30 further defines a sub-assembly of the seat track assembly 20.

Referring to FIGS. 2, 5 and 6, additional details of the tracks 24 and 26 will now be described. The upper track 26 may be structured and configured to slide relative to the lower track 24. If desired, the upper track 26 may be structured and

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configured to slide relative to the lower track **24** with the assistance of multiple balls or rollers (not shown) disposed between the tracks **24** and **26** in the space **25**. The tracks **24** and **26** may have any suitable construction. On the pin side **20A** of the seat track assembly **20**, the upper track **26** includes a first wall **26A1** and a second wall **26B1**. On the plate side **20B** of the seat track assembly **20**, the upper track **26** includes a first wall **26A2** and a second wall **26B2**. The first walls **26A1** and **26A2** extend downwardly from lateral edges of a top plate **26C**. The second walls **26B1** and **26B2** have a substantially serpentine cross-sectional shape and extend upwardly from a lower end of the walls **26A1** and **26A2**, respectively.

In the illustrated embodiment, the upper track **26** includes a plurality of first openings **216** formed in the first wall **26A1**, and a plurality of second openings **218** formed in the second wall **26B1**, and horizontally aligned with the first openings **216**. The openings **216** and **218** are spaced from one another along a portion of the length of the walls **26A1** and **26B1**, respectively. The illustrated first openings **216** are substantially rectangular in shape, although the first openings **216** may have any other desired shape, such as a trapezoidal shape. The illustrated walls **26A1** and **26B1** have three openings formed therein. Alternatively, the upper track **26** may also have any desired number of first openings **216** and second openings **218** formed therein.

In the illustrated embodiment, the upper track **26** includes a plurality of first openings **217** formed in the first wall **26A2**, and a plurality of second openings **219** formed in the second wall **26B2**, and horizontally aligned with the first openings **217**. The openings **217** and **219** are spaced from one another along a portion of the length of the walls **26A2** and **26B2**, respectively. The illustrated first openings **217** are substantially rectangular in shape, although the first openings **217** may have any other desired shape, such as a trapezoidal shape. The illustrated walls **26A2** and **26B2** have four openings formed therein. Alternatively, the upper track **26** may also have any desired number of first openings **217** and second openings **219** formed therein.

On the pin side **20A** of the seat track assembly **20**, the lower track **24** includes a first wall **24A1** and a second wall **24B1**. On the plate side **20B** of the seat track assembly **20**, the lower track **24** includes a first wall **24A2** and a second wall **24B2**. The second walls **24B1** and **24B2** extend upwardly from lateral edges of a substantially planar base plate **24C**. The first walls **26A1** and **26A2** are substantially parallel with the second walls **24B1** and **24B2**.

In the illustrated embodiment, the lower track **24** includes a plurality of third openings **220** formed in the first wall **24A1**. The lower track **24** also includes a plurality of third openings **221** formed in the first wall **24A2**. The openings **220** are horizontally aligned with the first and second openings **216** and **218**, and the openings **221** are horizontally aligned with the first and second openings **217** and **219**. The wall **24A1** and **24A2** may have a relatively large number of openings **220** and **221**, respectively, permitting numerous positions of the seat **10** relative to the vehicle floor **18** when locked, as will be explained below. The illustrated openings **220** and **221** are substantially rectangular in shape, although the openings **220** and **221** may have any other desired shape, such as a trapezoidal shape. The lower track **24** may have any desired number of third openings **220** and **221** formed therein.

In the illustrated embodiments, the PEL **30** is disposed within the cavity **27** of the track assembly **20** between the lower and upper tracks **22** and **26**. A portion of the PEL **30**, such as visible in FIG. **2**, extends outwardly (upwardly when viewing FIGS. **2**, **5**, and **6**) through an opening **28** formed in the top plate **26C** of the upper track **26**. An advantage of this

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configuration is that the PEL **30** occupies a smaller volume of space than a conventional locking mechanism in which most of the locking mechanism is located outside of the cavity **27**.

FIGS. **5** and **6** are cross section elevational views of the longitudinal seat adjustment apparatus **22**. FIG. **5** illustrates a first pin, such as the pin **106A**, urged outwardly through the first wall **26A1**, the first wall **24A1**, and the second wall **26B1** a maximum distance.

FIG. **6** illustrates a locking plate, such as the locking plate **114A**, urged outwardly through the first wall **26A2**, the first wall **24A2**, and the second wall **26B2** a maximum distance.

The first pin **106A** is carried by the second or upper track **26** and is slidably movable between an engaged position such that the first pin **106A** extends through one of the plurality of openings **220** formed in the first wall **24A1** of the lower track **24** and a disengaged position such that the first pin **106A** is retracted from the opening **220**. Similarly, the locking plate **114A** is carried by the upper track **26** and is slidably movable between an engaged position such that the plate **114A** extends through two of the openings **221** formed in the first wall **24A2** and a disengaged position such that the plate **114A** is retracted from the openings **221**.

In operation, as best shown in FIG. **5**, the first lever **40** may be rotated by a portion of a PEL actuator such as the release handle **406** of the PEL actuator **400** shown in FIG. **16**, in the direction of the arrow A (clockwise when viewing FIGS. **5** and **6**), thereby causing the second lever **42** to rotate in the direction of the arrow B (counterclockwise when viewing FIGS. **5** and **6**). As best shown in FIG. **6**, the first lever **40** then contacts the mounting ring **120** of the plates **114A**, **114B**, and urges the plates **114A**, **114B** inwardly (in the direction of the arrow D), and causing the plates **114A**, **114B** to disengage the second wall **26B2** and the first wall **24A2**. Likewise, as best shown in FIG. **5**, the second lever **42** contacts the mounting ring **110** of the pins **106A**, **106B**, **106C**, and urges the pins **106A**, **106B**, **106C** inwardly (in the direction of the arrow C), and causing the pins **106A**, **106B**, **106C** to disengage the second wall **26B1** and the first wall **24A1**. When the pins **106A**, **106B**, **106C**, and the plates **114A** and **114B** are disengaged from the second walls **26B1** and **26B2**, and the first walls **24A1** and **24A2**, the upper track **26** can slide relative to the lower track **24**.

In the embodiments illustrated herein, three pins **106A**, **106B**, **106C** are provided. The three pins **106A**, **106B**, **106C** substantially eliminate free-play. After the release handle **406** is released, and the pins **106A**, **106B**, **106C** and the plates **114A** and **114B** of the PEL **30** are urged into positions engaging the walls **26A1**, **26A2**, **24A1**, **24A2**, and the load bracket **44** (such as shown in FIG. **7**), at least two of the pins **106A**, **106B**, **106C** (the pins **106B** and **106C** in FIG. **7**) will always engage both the upper track **26** and the lower track **24**. Therefore, when the seat **16** is moved forwardly or rearwardly, at least two pins **106A**, **106B**, **106C** will engage both the upper track **26** and the lower track **24**, thereby substantially eliminating free-play.

In the embodiments illustrated herein, when the release handle **406** is released, one of the plates (the plate **114A** in FIG. **7**), extends through the openings **217**, **221**, and **219** in each of the three walls **26A2**, **24A2**, and **26B2** respectively, thus further securing the upper track **26** relative to the lower track **24**. The plate **114A** also acts to substantially reduce bending force on the walls, **26A2**, **24A2**, and **26B2** that may occur during an impact or crash event.

Advantageously, the operation of the PEL **30** is split such that the pins **106A**, **106B**, **106C** extend outwardly toward, and engage the pin side **20A** of the track assembly **20**, and the

plates **114A** and **114B** extend outwardly toward, and engage a plate side **20B** opposite the pin side **20A**.

FIG. 7 illustrates exemplary alternate positions of the pins **106A**, **106B**, **106C** and the plates **114A** and **114B** relative to the tracks **24** and **26** depending on the relative positions of the first, second, and third openings **216**, **217**, **218**, **219**, **220**, and **221**.

For example, FIG. 7 shows the plate **114A** fully outwardly extended such that the fingers **118** extend through the walls **26A2**, **24A2**, and **26B2**, while the plate **114B** extends only through the wall **26A2**.

In the embodiment illustrated in FIG. 7, the pins **106B** and **106C** are urged outwardly a maximum distance through the walls **26A1**, **24A1**, and **26B2**, such that a surface of the pins **106B** and **106C** engage openings **220** of the wall **24A1** at points of contact indicated at **202** and **204**, respectively, thereby urging the pins **106B** and **106C** slightly laterally outwardly (i.e., substantially perpendicularly to a longitudinal axis of the pins **106B** and **106C**). The pins **106B** and **106C** are thereby urged slightly laterally into engagement with the openings **216** as indicated at **222** and **224**. An end of the pin **106A** will also engage the wall **24A1**.

Advantageously, as shown in FIG. 7, each pin **106B** and **106C** engages the PEL **30** at three points. The pins **106B** and **106C** further engage the grooves **104** of the load bracket **44** at the contact points **226** and **228**.

The three points of contact of the pins **106B** and **106C** with the PEL **30**, and the positions of each pin relative to the other, wherein the longitudinal axis of the pins **106B** and **106C** are not parallel, ensure that each pin **106B** and **106C** remain engaged at three contact points each, thereby substantially eliminating free play of the seat track assembly **20**.

Advantageously, the PEL **30** is structured such that when the PEL **30** is in a locked position, two of the pins **106A**, **106B**, and **106C** are always extended a maximum distance outwardly and engage the PEL at three points of contact as shown in FIG. 7.

Referring now to FIG. 8, a second embodiment of a seat track assembly is shown generally at **300**. The seat track assembly **300** has a first or free-play elimination side **300A** and a second or load side **300B**, and includes a first seat support member or lower track **302** that is attachable to the vehicle **14**, and a second seat support member or upper track **304** that is attached to the seat bottom **16** and movable longitudinally with respect to the lower track **302**. The seat track assembly **300** further includes a second embodiment of the positively engaged locking system or PEL **306**.

FIGS. 9 and 10 show first and second sides **308** and **310** of the PEL **306**, respectively. The illustrated PEL **306** includes a first housing portion **312** and a second housing portion **314**, both also shown in FIGS. 13 and 14. The illustrated PEL **306** also includes a first lever **316** and a second lever **318**. The first and second housing portions **312** and **314**, respectively, are mounted to a third housing portion or load bracket **320**.

The first housing portion **312** includes a body **322** having an elongated pivot surface **324**. Apertures may be formed through the body **322** through which free play elimination pins **330A**, **330B**, and **330C**, and locking pins **332A**, **332B**, **332C**, and **332D** may extend. The second housing portion **314** includes a body **334** having an elongated pivot surface **336**. Apertures may be formed through the body **334** through which the pins **330A**, **330B**, and **330C**, and the pins **332A**, **332B**, **332C**, and **332D** may extend.

The first lever **316**, as shown in FIGS. 13 and 14, includes a body **338** having a first side **338A** having a pivot groove **343** which pivotally engages the pivot surface **324**. A second side **338B** includes a plurality of first teeth **341**.

The second lever **318**, as also shown in FIGS. 13 and 14, includes a body **344** having a first side **344A** having a pivot groove **340** which pivotally engages the pivot surface **336**. A second side **338B** includes a plurality of second teeth **342**.

The load bracket **320** includes an elongated generally U-shaped body **350** having outwardly extending arms **352**. Attachment posts **354** extend outwardly toward the upper track **304** for attaching the load bracket **320** to the upper track **304**. Apertures **356** are formed in the arms **352** for receiving attachment pins (not shown) for attaching the body **350** to the first and second housing portions **312** and **314**, respectively.

The first housing portion **312**, the first lever **316**, and the springs **372** define a first actuator **313**. The second housing portion **314**, the second lever **318**, and the springs **372** define a second actuator **315**.

As best shown in FIGS. 9, 12, and 15, the pins **330A**, **330B**, and **330C** are identical and include a pin body **358**. The pin body **358** has a first portion **358A** having a substantially rectangular transverse section, a longitudinally tapered second portion **358B**, and a tapered end portion **358C**. A spring flange **360** extends outwardly from the pin body **358** (upwardly when viewing FIG. 13). A spring mounting boss **362** extends outwardly from the spring flange **360** (to the right when viewing FIG. 13).

As best shown in FIGS. 10, 11, and 15, the PEL **306** includes four load or locking pins **332A**, **332B**, **332C**, and **332D**. The locking pins **332A**, **332B**, **332C**, and **332D** are identical and include a pin body **364**. The pin body **364** has a substantially rectangular transverse section and a tapered end portion **366**. A spring flange **368** extends outwardly from the pin body **364** (upwardly when viewing FIG. 14). A spring mounting boss **370** extends outwardly from the spring flange **368** (to the left when viewing FIG. 14).

FIG. 9 shows the first side **308** of the PEL **306** with the second housing portion **314** and the second lever **318** removed. In the illustrated embodiment, coil springs **372** extend between a spring boss **323** on the first housing portion **312** and the spring flange **360** of the pins **330A**, **330B**, and **330C**. As best shown in FIG. 13, the springs **372** are seated on the spring mounting bosses **362** of each pin **330A**, **330B**, and **330C**. The springs **372** bias the free play elimination pins **330A**, **330B**, and **330C** outward of the load bracket **320**.

FIG. 10 shows the second side **310** of the PEL **306** with the first housing portion **312** and the first lever **316** removed. The coil springs **372** also extend between a spring boss **335** on the second housing portion **314** and the spring flange **368** of the locking pins **332A**, **332B**, **332C**, and **332D**. As best shown in FIG. 14, the springs **372** are seated on the spring mounting bosses **370** of each locking pins **332A**, **332B**, **332C**, and **332D**. The springs **372** bias the locking pins **332A**, **332B**, **332C**, and **332D** outward of the load bracket **320**. It will be understood that the PEL **306** further defines a sub-assembly of the seat track assembly **300**.

Referring to FIGS. 9, 13, and 14, additional details of the tracks **302** and **304** will now be described. The upper track **304** may be structured and configured to slide relative to the lower track **302**. If desired, the upper track **304** may be structured and configured to slide relative to the lower track **302** with the assistance of multiple balls or rollers (not shown) disposed between the tracks **302** and **304** in the space **305**.

On the free-play side **300A** of the seat track assembly **300**, the upper track **304** includes a first wall **304A1** and a second wall **304B1**. On the plate side **300B** of the seat track assembly **300**, the upper track **304** includes a first wall **304A2** and a second wall **304B2**. The first walls **304A1** and **304A2** extend downwardly from lateral edges of a top plate **304C**. The second walls **304B1** and **304B2** have a substantially serpen-

tine cross-sectional shape and extend upwardly from a lower end of the walls 304A1 and 304A2, respectively.

In the illustrated embodiment, the upper track 304 includes a plurality of first openings 374 formed in the first wall 304A1, and a plurality of second openings 376 formed in the second wall 304B1, and horizontally aligned with the first openings 374. The openings 374 and 376 are spaced from one another along a portion of the length of the walls 304A1 and 304B1, respectively. The illustrated first openings 374 are substantially rectangular in shape, although the first openings 374 may have any other desired shape, such as a trapezoidal shape. The illustrated walls 304A1 and 304B1 have three openings formed therein. Alternatively, the upper track 304 may also have any desired number of first openings 374 and second openings 376 formed therein.

In the illustrated embodiment, the upper track 304 includes a plurality of first openings 375 formed in the first wall 304A2, and a plurality of second openings 377 formed in the second wall 304B2, and horizontally aligned with the first openings 375. The openings 375 and 377 are spaced from one another along a portion of the length of the walls 304A2 and 304B2, respectively. The illustrated first openings 375 are substantially rectangular in shape, although the first openings 375 may have any other desired shape, such as a trapezoidal shape. The illustrated walls 304A2 and 304B2 have four openings formed therein. Alternatively, the upper track 304 may also have any desired number of first openings 375 and second openings 377 formed therein.

On the free-play side 300A of the seat track assembly 300, the lower track 302 includes a first wall 302A1 and a second wall 302B1. On the load side 300B of the seat track assembly 300, the lower track 302 includes a first wall 302A2 and a second wall 302B2. The second walls 302B1 and 302B2 extend upwardly from lateral edges of a substantially planar base plate 302C. The first walls 304A1 and 304A2 are substantially parallel with the second walls 302B1 and 302B2.

In the illustrated embodiment, the lower track 302 includes a plurality of third openings 378 formed in the first wall 302A1. The lower track 302 also includes a plurality of third openings 379 formed in the first wall 302A2. The openings 378 are horizontally aligned with the first and second openings 374 and 376, and the openings 379 are horizontally aligned with the first and second openings 375 and 377. The wall 302A1 and 302A2 may have a relatively large number of openings 378 and 379, respectively, permitting numerous positions of the seat 10 relative to the vehicle floor 18 when locked, as will be explained below. The illustrated openings 378 and 379 are substantially rectangular in shape, although the openings 378 and 379 may have any other desired shape, such as a trapezoidal shape. The lower track 302 may have any desired number of third openings 378 and 379 formed therein.

In the illustrated embodiments, the PEL 306 is disposed within the interior space or cavity 301 of the track assembly 300 between the lower and upper tracks 302 and 304. A portion of the PEL 306, such as visible in FIG. 8, extends outwardly (upwardly when viewing FIGS. 8, 13, and 14) through an opening 303 formed in the top plate 304C of the upper track 304. An advantage of this configuration is that the PEL 306 occupies a smaller volume of space than a conventional locking mechanism in which most of the locking mechanism is located outside of the cavity 301.

FIGS. 13 and 14 are cross section elevational views of the longitudinal seat track assembly 300. FIG. 13 illustrates a first pin, such as the pin 330A, urged outwardly through the first wall 304A1, the first wall 302A1, and the second wall 304B1 a maximum distance.

FIG. 14 illustrates a locking pin, such as the locking pin 332B, urged outwardly through the first wall 304A2, the first wall 302A2, and the second wall 304B2 a maximum distance.

The first pin 330A is carried by the second or upper track 304 and is slidably movable between an engaged position such that the first pin 330A extends through one of the plurality of openings 378 formed in the first wall 302A1 of the lower track 302 and a disengaged position such that the first pin 330A is retracted from the opening 378. Similarly, the second pin 332A is carried by the upper track 304 and is slidably movable between an engaged position such that the pin 332A extends through one of the plurality of openings 379 formed in the first wall 302A2 and a disengaged position such that the pin 332A is retracted from the opening 379.

In operation, as best shown in FIG. 13, the first lever 316 may be rotated by a portion of a PEL actuator 400, described below, in the direction of the arrow A1 (clockwise when viewing FIGS. 13 and 14), thereby causing the second lever 318 to rotate in the direction of the arrow B1 (counterclockwise when viewing FIGS. 13 and 14). As best shown in FIG. 14, the first lever 316 then contacts the spring flange 368 of the locking pins 332A, 332B, 332C, and 332D, and urges the locking pins 332A, 332B, 332C, and 332D inwardly (in the direction of the arrow D1), and causing the locking pins 332A, 332B, 332C, and 332D to disengage the first wall 304A2 and the second wall 304B2.

An exemplary embodiment of a PEL actuator is shown at 400 in FIGS. 16 and 17. The PEL actuator 400 includes a pivot/mounting rod 402 attached between opposing seat track assemblies 300. A cap or mounting portion 404 is attached to either the first lever 316 or the second lever 318, depending on the sided of the seat 10 that PEL actuation is desired. A release handle 406 extends forwardly from the pivot/mounting rod 402. A first or forward end 408A of a release arm 408 extends rearwardly from the pivot/mounting rod 402. A second or rearwardly facing end 408B of the release arm 408 is biased into engagement with an upwardly facing surface 404A of the mounting portion 404 by a spring 410. When the release handle 406 is moved upwardly, the rearwardly facing end 408B of the release arm 408 urges the upwardly facing surface 404A of the mounting portion 404 downwardly, thus causing the lever 318 to rotate in the direction of the arrow A1, as described above.

Likewise, as best shown in FIG. 13, the second lever 318 contacts the spring flange 360 of the pins 330A, 330B, 330C, and urges the pins 330A, 330B, 330C inwardly (in the direction of the arrow C1), and causing the pins 330A, 330B, 330C to disengage the first wall 302A1 and the second wall 304B1. When the free play elimination pins 330A, 330B, 330C, and the locking pins 332A, 332B, 332C, and 332D are disengaged from the first wall 302A and the second wall 304B, the upper track 304 can slide relative to the lower track 302.

In the embodiments illustrated herein, three pins 330A, 330B, 330C are provided. The three pins 330A, 330B, 330C substantially eliminate free-play. After the release handle 406 is released, and the pins 330A, 330B, 330C and the locking pins 332A, 332B, 332C, and 332D of the PEL 306 are urged into positions engaging the walls 304A1, 304A2, 302A1, 302A2, and 304B1 and 304B2 (such as shown in FIG. 15), at least two pins 330A, 330B, 330C will always engage both the upper track 304 and the lower track 302. Therefore, when the seat 16 is moved forwardly or rearwardly, at least two pins 330A, 330B, 330C will engage both the upper track 304 and the lower track 302, thereby substantially eliminating free-play.

In the embodiments illustrated herein, when the release handle 406 is released, at least three of the locking pins 332A,

332B, 332C, and 332D (the locking pins 332B, 332C, and 332D in FIG. 15), extends through the openings 375, 379, and 377 in each of the three walls 304A2, 302A2, and 304B2, respectively, thus further securing the upper track 304 relative to the lower track 302. Because the three locking pins 332B, 332C, and 332D engage both walls 304A2 and 304B2 of the upper track 304, the load performance of the seat track assembly 300 during an impact or crash event is improved. The locking pins 332B, 332C, and 332D also act to substantially reduce bending force on the walls, 304A2, 302A2, and 304B2 that may occur during an impact or crash event.

Advantageously, the operation of the PEL 306 is split such that the pins 330A, 330B, 330C extend outwardly toward, and engage the free-play elimination side 300A of the seat track assembly 300, and the locking pins 332A, 332B, 332C, and 332D extend outwardly toward, and engage a load side 300B opposite the free-play elimination side 300A.

FIG. 15 illustrates exemplary alternate positions of the pins 330A, 330B, 330C and the locking pins 332A, 332B, 332C, and 332D relative to the tracks 302 and 304 depending on the relative positions of the first, second, and third openings 374, 375, 376, 377, 378, and 379.

For example, FIG. 15 shows the locking pins 332B, 332C, and 332D fully outwardly extended such that they extend through the walls 304A2, 302A2, and 304B2, while the locking pin 332A extends only through wall 304A2.

In the embodiment illustrated in FIG. 15, the pins 330A and 330C are urged outwardly a maximum distance through the walls 304A1, 302A1, and 304B 1, such that a surface of the pins 330A and 330C engage openings 378 of the wall 302A1 at points of contact indicated at 380 and 382, respectively, thereby urging the pins 330A and 330C slightly laterally outwardly (i.e., substantially perpendicularly to a longitudinal axis of the pins 330A and 330C). The pins 330A and 330C are thereby urged slightly laterally into engagement with the openings 374 as indicated at 384 and 388. An end of the pin 330B will also engage the wall 302A1.

Additionally, as shown in FIG. 15, each pin 330A and 330C engages the PEL 306 at three points. As the tapered end of the pin 330A engages the opening 378 of the wall 302A at the contact point 380, the pin 330A is urged slightly laterally outwardly. The pin 330A then engages the first opening 374 of the wall 304A at the contact point 384, and further engages the pin groove 392 of the load bracket 320 at the contact point 386. Similarly, the tapered end of the pin 330C engages the opening 378 of the wall 302A at the contact point 382. The pin 330C is then urged slightly laterally outwardly. The pin 330C then engages the first opening 374 of the wall 304A1 at the contact point 388, and further engages the pin groove 392 of the load bracket 320 at the contact point 390.

The three points of contact of the pins 330A and 330C with the PEL 306, and the positions of each pin relative the other, wherein the longitudinal axis of the pins 330A and 330C are not parallel, ensure that two pins (330A and 330C in FIG. 15) remain engaged at three contact points each, thereby substantially eliminating free play of the seat track assembly 300.

Advantageously, the PEL 306 is structured such that when the PEL is in a locked position, two of the pins 330A, 330B, and 330C are always extended a maximum distance outwardly and engage the PEL at three points of contact as shown in FIG. 15.

Referring now to FIG. 18, a third embodiment of a portion of a lower track is shown schematically at 502, and a portion of a third embodiment of the PEL is shown schematically at 512. The lower track 502 is similar to the lower track 302 and includes a first wall 502A1 substantially similar to the first wall 302A1 and a second wall 502A2. The first wall 502A1

includes openings 504 substantially similar to the openings 378. The free-play elimination pins schematically illustrated at 506A, 506B, and 506C are substantially similar to the free-play elimination pins 330A, 330B, and 330C, respectively.

The second wall 502A2 includes openings 510 having a width smaller than a width of the openings 379 in the second wall 302A2. The locking pins 508A, 508B, and 508C are substantially similar to the locking pins 332A through 332D. In the illustrated embodiment of the PEL 512 only three locking pins 508A, 508B, and 508C are provided. It will be understood that the operation of the PEL 512 is substantially similar to the operation of the PEL 306 described above.

It will be understood that in the engaged position, at least two of the locking pins 508A, 508B, and 508C will also extend through openings in both walls of the upper track (not shown in FIG. 18, but substantially similar to the walls 304A2 and 304B2 of the upper track 304 shown in FIG. 15). Because two of the three locking pins 508A, 508B, and 508C engage both walls of the upper track, the load performance of the associated seat track assembly is improved during an impact or crash event.

The principle and mode of operation of the vehicle seat track assembly have been described in its preferred embodiment. However, it should be noted that the vehicle seat track assembly described herein may be practiced otherwise than as specifically illustrated and described without departing from its scope.

What is claimed is:

1. A vehicle seat track assembly comprising:

a first track having first and second spaced apart walls, wherein each of said first and second walls includes a plurality of openings formed therein;

a second track slidably mounted relative to said first track; and

a locking mechanism including:

a first pin carried by said second track and axially movable between an engaged position, wherein said first pin extends through one of the plurality of openings formed in said first wall of said first track, and a disengaged position, wherein said first pin is retracted from said plurality of openings formed in said first wall of said first track; and

a second pin carried by said second track and axially movable between an engaged position, wherein said second pin extends through one of the plurality of openings formed in said first wall of said first track, and a disengaged position, wherein said second pin is retracted from said plurality of openings formed in said first wall of said first track;

wherein said first and second pins are also laterally movable relative to one another when moving into their respective engaged positions.

2. The vehicle seat track assembly according to claim 1, wherein said locking mechanism defines a positively engaged locking (PEL) mechanism.

3. The vehicle seat track assembly according to claim 1, further including a plurality of first pins.

4. The vehicle seat track assembly according to claim 3, wherein in the engaged position, at least two first pins extend through one of the plurality of openings formed in said first wall of said first track.

5. The vehicle seat track assembly according to claim 4, wherein each of said at least two first pins engage said first track within said opening in said first wall.

6. The vehicle seat track assembly according to claim 5, wherein said second track has first and second spaced apart

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walls; and wherein each of said first and second walls includes a plurality of openings formed therein.

7. The vehicle seat track assembly according to claim 6, wherein in the engaged position, each of said at least two first pins further engage said second track within said opening in said first wall.

8. The vehicle seat track assembly according to claim 7, wherein said first pins are slidably mounted to a housing portion; and wherein in the engaged position, each of said at least two first pins further engage said housing portion.

9. The vehicle seat track assembly according to claim 1, further including a plurality of second pins.

10. The vehicle seat track assembly according to claim 9, wherein in the engaged position, at least three second pins extend through one of the plurality of openings formed in said second wall of said first track.

11. The vehicle seat track assembly according to claim 10, wherein each of said at least three second pins engage said first track within said opening in said second wall.

12. The vehicle seat track assembly according to claim 11, wherein said second track has first and second spaced apart walls; and wherein each of said first and second walls includes a plurality of openings formed therein.

13. The vehicle seat track assembly according to claim 12, wherein in the engaged position, each of said at least three second pins further engage said second track within said opening in said first wall.

14. The vehicle seat track assembly according to claim 13, wherein said second pins are slidably mounted to a housing portion.

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15. The vehicle seat track assembly according to claim 14, wherein in the engaged position, each of said at least three second pins further engage said housing portion.

16. The vehicle seat track assembly according to claim 9, wherein the plurality of second pins includes a pair of connected second pins; and wherein in the engaged position, each of said pair of connected second pins extend through one of the plurality of openings formed in said second wall of said first track.

17. The vehicle seat track assembly according to claim 1, further including first and second actuators carried by said second track and pivotally mounted relative to said second track.

18. The vehicle seat track assembly according to claim 17, wherein said second track has first and second spaced apart walls defining an interior space therebetween; and wherein said first and second pins are disposed within said interior space of said second track when said first and second pins are in their respective disengaged positions.

19. The vehicle seat track assembly according to claim 18, wherein said first and second pins and said first and second actuators are mounted within a housing; and wherein said housing, said first and second pins, and said first and second actuators define a vehicle seat track assembly sub-assembly.

20. The vehicle seat track assembly according to claim 19, wherein said sub-assembly is mounted to said second track within said interior space of said second track.

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